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(71) Applicant (for all designated States except US): **METSO PAPER, INC.** [FI/FI]; Fabianinkatu 9 A, FI-00130 Helsinki (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **KEMPPAINEN, Matti** [FI/FI]; Temmonkaari 2, FI-05400 Jokela (FI). **RIIHELÄ, Vesa** [FI/FI]; Kytötie 57 B as. 2, FI-04430 Järvenpää (FI). **KOJO, Teppo** [FI/FI]; Alhontie 10, FI-04600

Mäntsälä (FI). **MÄKINEN, Risto** [FI/FI]; Koivikonkaari 24, FI-04600 Mäntsälä (FI). **NAATTI, Ilkka** [FI/FI]; Norppatie 27 A, FI-01480 Vantaa (FI). **TIILIKAINEN, Marko** [FI/FI]; Toimelantie 22 C, FI-04500 Kellokoski (FI).

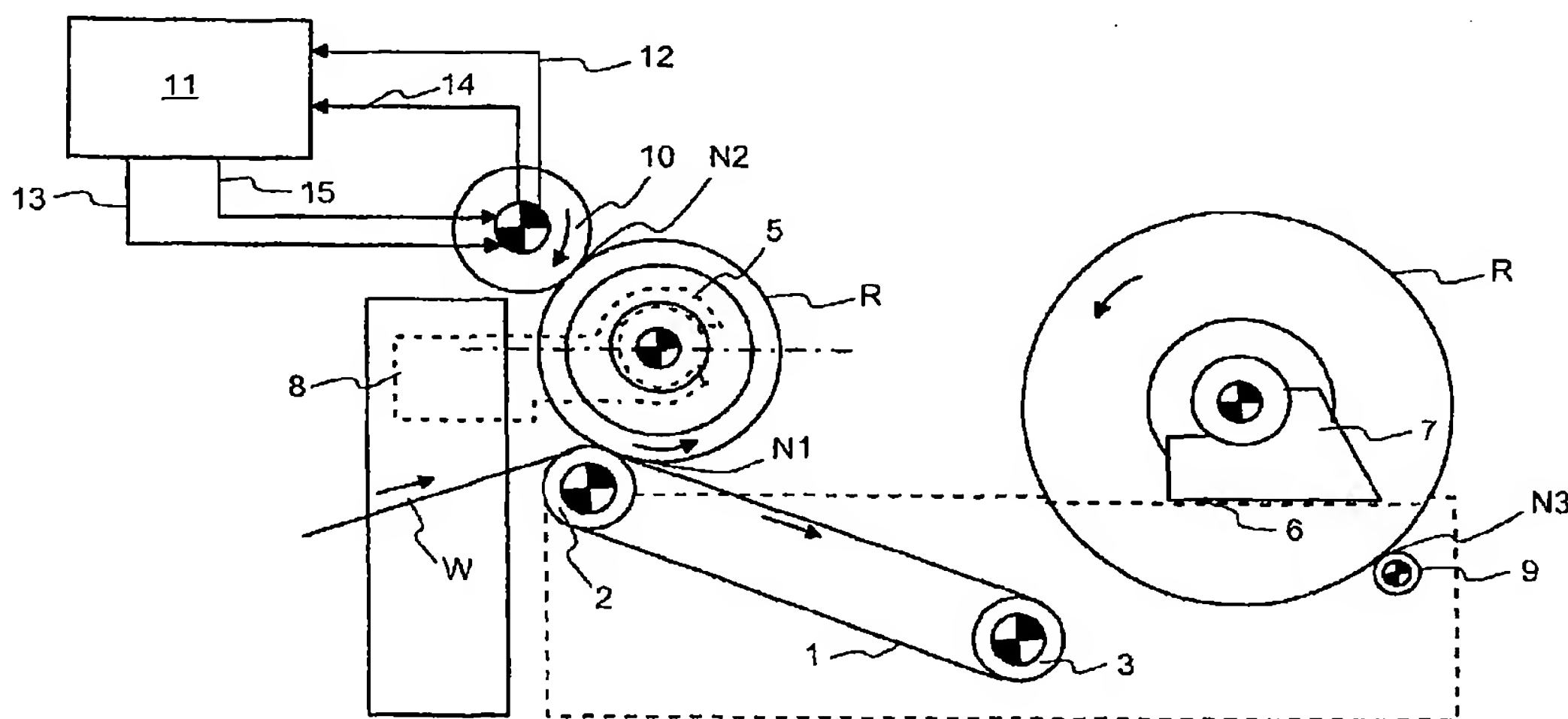
(74) Agent: **TAMPEREEN PATENTTITOIMISTO OY**; Hermiankatu 12 B, FI-33720 Tampere (FI).

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(54) Title: METHOD IN REELING UP AND A REEL-UP



(57) Abstract: The invention relates to a method and an apparatus in reeling up, in which a paper web or the like (W) is reeled around a center-driven reel spool (5), which is transferred from the primary reeling to the secondary reeling, in which reeling the reel spool (5) is transferred in accordance with the growth of the reel by means of a transfer device (7) at least at some stage of the reeling and the web is brought at said stage from below the reel spool (5) via a reeling nip (N1) formed by the reel spool (5) and a loop (1) of an endless supporting member. According to the invention the web (W) is guided around the reel spool (5) during the reeling via an auxiliary nip (N2) formed by means of the reel spool (5) and the roll (10, 10').



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## Method in reeling up and a reel-up

The invention relates to a method in reeling up, which is of the type presented in the preamble of the appended claim 1. The invention also  
5 relates to a reel-up, which is of the type presented in the preamble of the appended claim 19.

In the final end of a paper machine or a finishing apparatus for paper, a paper web which is typically several meters wide and which has been  
10 produced and/or treated in preceding machine sections, is reeled around a reel spool to form a machine reel. In this reeling up process a reeling cylinder that is bearing-mounted rotatable is typically used for guiding the paper web on the machine reel, wherein the nip contact between the reeling cylinder and the machine reel is utilized to  
15 influence the quality of the reel produced thereby. In a conventional solution the reeling cylinder remains stationary and the reel spool around which the reel is accumulated in nip contact is moved during reeling up in a supporting structure, for example by supporting the ends of the reel spool on reeling rails. The ends of the reel spool are  
20 affected by means of a suitable loading mechanism to adjust the nip contact between the machine reel that is being formed and the reeling cylinder. Such reeling concepts and loading methods related thereto are disclosed, for example, in the Finnish patent 91383 and in the corresponding US patent 5,251,835, as well as in the Finnish patent  
25 application 950274 and in the corresponding US patent 5,690,298.

Another known solution is the one in which the reeling cylinder is arranged to move on a carriage, and the machine reel is rotated with a  
30 center drive in a stationary reeling station, i.e. the location of the center of the reel spool remains the same. When the radius of the machine reel grows, the reeling cylinder shifts in such a manner that the carriage supporting the same moves in the guide. Such an arrangement is disclosed, for example, in the European application publication 792829 and in the corresponding US patent 5,988,557.

35 US patent 5,370,327 discloses a solution in which the reeling cylinder moves in the vertical direction, thus making it possible to maintain the

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angular position of the nip between the reeling cylinder and the machine reel substantially constant when the reel moves on reeling rails. The low position of the reeling cylinder and the movement of the same in the vertical direction make it possible to transfer the reel  
5 spools from a storage to a reeling station along a straight transfer path. The solution contains two pairs of reeling carriages, of which the pair that has delivered the full machine reel can return past the other pair that is guiding the reel to be reeled, to retrieve a new empty reel spool.

10 According to the Finnish patent application 950274 and the corresponding US patent 5,690,298 it is possible to use an auxiliary roll located at a lower position and moving in the vertical direction in addition to the stationary reeling cylinder that guides the web on the reel, said auxiliary roll forming a second nip with the machine reel  
15 produced in the moving reeling station. Before the change this auxiliary roll is in contact with the reel that is becoming full, which has been run off the reeling cylinder. A corresponding arrangement in connection with a change is disclosed in the Finnish patent 91383/ US patent 5,251,835.

20 In addition, the publication EP-860391 discloses a reeler, in which the web is guided on a reel via a belt or a wire, which is led via guiding rolls. Thus, by means of the belt or the wire, a long reeling nip having an even pressure is provided on the area of the lower half of the reel.  
25 The pressure can be adjusted through the tension of the belt or the wire. The belt or wire loop can be tilted in the vertical plane in such a manner that the first guiding roll in the travel direction of the web can be lifted against the new reel spool, which rests on reeling rails above the belt. When the reel grows it moves forward on the reeling rails in  
30 such a manner that it is constantly in contact with the downwards-tilted run of the wire or belt, which follows the guiding roll and via which the web comes on the reel.

Furthermore, the patent US-5531396 discloses a reeler, in which the  
35 wire loop is guided over the reeling cylinder in such a manner that it guides the web after the reeling cylinder on the reel that is being formed.

In reelers utilizing a wire or a belt, problems are caused by the flaws produced in the reel during the primary reeling. The belt nip is soft, which results in that the bottom of the reel can also become soft. It is  
5 difficult to tighten the bottom of the reel in belt reeling only with the belt nip, which may cause for instance internal slip in the reel in the direction of the periphery of the reel and/or in the axial direction.

The nip pressure of the soft belt nip is also smaller, for example only  
10 approximately one tenth of the nip pressure produced by the roll nip. Due to the small nip pressure the friction force between the surface layers of the reel that is being formed, i.e. the resistance against mutual transverse slip remains small in the belt nip. It is, of course, possible to increase the nip pressure of the belt nip by increasing the  
15 tension of the belt, but this requires both heavy and very expensive wire guiding rolls, devices for moving the belt guiding rolls and frame structures of the reel-up. Furthermore, especially when reeling slippery paper grades, the belt tension must be very high, for example over 20 kN/m to attain sufficient nip pressure.

20 The purpose of the invention is to provide a new reeling up method using a belt and a wire, by means of which the reeling can be better implemented by simultaneously preserving the advantages of known methods. To attain this purpose, the method according to the invention  
25 is primarily characterized in what will be presented in the characterizing part of the appended claim 1. The reel-up according to the invention, in turn, is characterized in what will be presented in the characterizing part of the appended claim 19.

30 As for the other embodiments of the invention and their advantages, reference is made to the appended dependent claims and to the description hereinbelow.

In the following, the invention will be described in more detail with  
35 reference to the appended drawings, in which



- Fig. 1 shows the main principle of the reel-up in a schematical side-view as well as a strongly reduced control diagram of the reeling according to the invention,
- 5 Figs 2 to 6 illustrate the different stages of the reeling up process according to an embodiment of the invention in a side view of the reel-up,
- 10 Figs 7 to 11 illustrate the different stages of the reeling up process according to a second embodiment of the invention in a side view of the reel-up, and
- 15 Figs 12 to 17 illustrate the different stages of the reeling up process according to a second embodiment of the invention in a side view of the reel-up.

Fig. 1 illustrates a continuously operating reel-up, where a paper web W, which is normally several meters wide and comes from a preceding section of a paper machine or a finishing apparatus for paper, travels

20 via a reeling nip N1 to a reel R. The reeling nip is formed by means of a flexible supporting member 1 in the form of an endless loop, such as a belt or a wire. The supporting member 1 is guided via two guiding rolls 2 and 3, at the location of each of which the run of the member 1 turns to the opposite direction. In the travel direction of the web the first

25 guiding roll 2 can form a "hard nip" with the reel being started at the initial stage of the reeling in such a manner that the supporting member 1 is in contact with the reel at a point where the member travels supported by the guiding roll 2 on the surface of the roll. The second

30 guiding roll 3 can be a driven roll, i.e. a traction roll, or separate drives can be arranged for both rolls. The web travels guided by the supporting member 1 onto the machine reel R, which is formed around a reel spool 5 rotatable with its own center drive. It is possible for the

35 reel spool 5 to move in the machine direction with respect to the loop of the supporting member 1, and this is arranged in such a manner that the bearing housings at the ends of the reel spool that enable the rotation of the reel spool 2 are supported on suitable supporting structures. In connection with the reel-up, there is also a storage of

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empty reel spools 5 (not shown), from which the rolls are brought to the change station at the first guiding roll 2 in order to change the web going to the machine reel R that is becoming full. The reel change takes place at production speed i.e. the paper web passed at high speed to the full reel is changed to travel onto a new, empty reel spool brought to the change station.

During the primary reeling, at least at some stage, when the reel spool 5 is still located in its place in the primary reeling device 8, an auxiliary nip N2 is formed by means of the roll 10 with the reel spool 5. The roll 10 is positioned in the upper part of the reel spool, more precisely above the surface of the reel spool restricted by the horizontal diameter of the same. Advantageously the roll 10 is arranged in a position sloping upward with respect to the reel spool, in other words horizontally with respect to the diameter, in an angle of 45 to 70 or 135 to 160 degrees, wherein the deflections resulting from the gravity of the roll and the nip load compensate each other. The roll 10 is moved by means of actuators attached to the frame of the primary reeling device. The roll 10 is a roll equipped with a center drive, having a shell which is in the axial direction at least as long as the width of the web to be reeled in its cross direction. Preferably the shells of the roll 10 and the reel spool 5 are equally long in the axial direction. The purpose of the roll 10 is to tighten the bottom of the reel that is being produced evenly on the entire width of the web at the primary reeling stage. Thus, it is possible to prevent internal slip of the reel and the reeling faults resulting therefrom. It is also possible to measure and adjust the loading force of the nip roll. The torque of the drive of the roll can also be adjusted, thus increasing or reducing the tightness of the reel. The roll 10 can be driven either during the entire primary reeling, or it can be driven only for a part of the time of the primary reeling.

The machine reel R can be transferred in the machine direction in a transfer device 7, which supports the bearing housings at the ends of the reel spool and which is moved by means of actuators attached to the frame of the reel-up. The transfer device 7 is arranged to move on substantially horizontal reeling rails 6 extending in the machine direction, and it is formed of a carriage at each end of the reel spool,

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which supports the bearing housing at the end of the reel spool 5. When the diameter of the machine reel R grows, and the reel moves forward, it is in continuous contact with the supporting member 1 because the transfer path of the transfer device 7 and the web-carrying portion of the supporting member 1 together form an angle opening in the transfer direction. In Fig. 1, the upper web-carrying portion of the loop of the supporting member 1 is directed diagonally downwards in its direction of movement, whereas the transfer path of the reel R and the reel spool 5 is substantially horizontal.

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Fig. 2 illustrates a situation in the primary stage of reeling up in a situation where the reel spool 5 and the reel R formed around it during primary reeling is transferred from the primary reeling device 8 to the transfer device 7, which operates as a secondary reeling device. For this purpose, the transfer device 7 is run in the direction pointed out by the arrow against the travel direction of the web at the location of the primary reeling device 8. The roll 10 is in the axial direction in contact with the surface of the reel R within its entire length, thus forming an auxiliary nip N2. At this stage the web W travels after the nip N1 formed by the supporting member 1 after the first guiding roll 2 and the reel R via the surface of the reel R to the nip N2 and further to the reel R. The nip N1 is formed below the surface of the reel spool defined by the horizontal diameter of the reel spool 5.

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Fig. 3 illustrates a situation where the transfer device 7 is transferred forward along the reeling rails 6 in the travel direction of the web according to the growth of the diameter of the reel R so that the reel is, at its lower side, always in contact with the loop of the supporting member 1. The formation of the bottom of the reel R has already taken place, wherein the effect of the auxiliary nip N2 formed by the roll 10 and the reel R is no longer required in the reeling. The reel spool 5 forming the core of the new reel is brought to the primary reeling device 8. The roll 10 is lifted up, and the nip N2 is open. In the situation of Fig. 3 the loop of the supporting member 1 has been transferred forward in the machine direction in such a manner that the first guiding roll 2 can be positioned directly below the new reel spool 5.



Fig. 4 illustrates a situation where the new reel spool 5, by vertically lowering the primary reeling device 8, has been brought to the change station in contact with that portion of the loop of the supporting member 1 that travels on the first guiding roll 2 in order to form a so-called hard nip. Before this the new reel spool 5 has been accelerated to the web speed with the drive of the primary reeling device 8, and the roll has been brought in contact with the reel spool 5. In comparison to the situation of Fig. 3, the old machine reel R has moved forward according to the growth of the reel diameter, i.e. the reeling nip N1 between the reel R and the loop of the supporting member has moved to the travel direction of the upper portion of the loop. The reel spool 5 can also be held in its place, and the loop of the supporting member can be moved in relation thereto, or both movement states can be combined. Now the paper web W travels between the new empty reel spool 5 and the first guiding roll 2 of the loop, and further along the upper web-carrying portion of the loop of the supporting member 1 and moves over to the periphery of the old reel R in the reeling nip N1. Fig. 4 further illustrates how in this stage the old reel R has come into contact with a press roll 9 that is bearing-mounted rotatable in the frame of the reel-up and rotated with a drive of its own, the purpose of which is to ensure the density of the surface layers of the reel. The press roll 9 forms a nip N3 with the reel R. The press roll 9 can also be positioned above the horizontal diameter of the reel R that is being formed, wherein the deflections caused by the gravity of the roll and the nip force compensate each other. In Fig. 4 broken lines show two possible locations for the press rolls 9' and 9''. These press rolls function and move in a similar manner as the press roll 9 presented in the figure and in the present description.

Fig. 5 illustrates a situation where the web going to the old reel R has been changed to travel around the new reel spool 5, i.e. after the nip N1 between the reel spool 5 and the first guiding roll 2, the web follows the surface of the new reel spool 5, travels further via the nip N2 and starts to form a new machine reel R around the reel spool. The change methods that are not described in more detail here may comprise suitable known methods, for example a cutting blade, water cutting, bag blowing, using tape in the change and blowings of air, by means of

which the web is brought to tear and to be guided around the new reel spool. The change is performed in a known manner at full web speed, i.e. at the production speed of the web.

- 5 Fig. 6 illustrates a situation where the old full machine reel R is transferred forward with the transfer device 7 to the removal station away from the contact with the loop of the supporting member 1 while the press roll 9 moves according to the transfer movement in such a manner that it is in continuous contact with the surface of the reel.
- 10 When a web layer of a certain thickness has been formed around the new reel spool, the loop of the supporting member 1 is transferred in a manner pointed out by the arrow against the travel direction of the web in such a manner that the first guiding roll 2 moves further away from the new reel, and the web is guided on a new reel in the point where
- 15 the surface of the reel is positioned against the portion of the supporting member 1 following immediately after the guiding roll 2, i.e. the situation is the same as in Fig. 2. When the full reel R has been removed from the reel-up, the transfer device 7 is free to move on the rails 6 towards the primary reeling device 8 into the position of Fig. 2,
- 20 where the reel spool in the primary reeling device 8 and the reel R that has started to form around it are delivered to the transfer device 7 for secondary reeling, which, in turn, proceeds along the loop in accordance with Figs 2 to 6.
- 25 Figs 7 to 11 show a second embodiment of the invention in which the reeling process itself corresponds to the stages shown in Figs 2 to 6. In this embodiment the web W is reeled around the reel spool in the primary reeling in such a manner that the web is first brought to the nip N2 via the periphery of the roll 10, and then to the nip N1 and further to
- 30 the reel R. Thus, the roll 10 functions simultaneously as a guiding roll of the web, and as a roll tensioning the bottom of the web. After the nip N2 the web is supported by means of a separate guiding roll 16 of paper, before it is brought to the nip N1.
- 35 Fig. 7 illustrates a situation at the primary stage of reeling up in which the reel R formed during the primary reeling is transferred to the transfer device 7, which thus operates as a secondary reeling device.

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During the reeling process the web is guided via the periphery of the roll 10 to the nip N2 formed by the roll 10 and the reel R formed around the reel spool, and thereafter via the paper guiding roll 16 to the nip N1 formed by the reel R and the supporting member 1 following the first  
5 guiding roll 2 and thus around the reel R that has been formed.

Fig. 8 shows a situation in which the transfer device is moved forward in the travel direction of the web as the reeling proceeds, and the lower side of the reel is in contact with the loop of the supporting member 1.  
10 The roll is transferred upward, away from the nip contact N1. However, the web moves continuously supported by the rolls 10 and 16 to the supporting member 1 and further to the reel R. Thus, at this stage the roll 10 functions as a paper guiding roll. The reel spool 5 forming the core of the new reel is brought to the primary reeling device 8. The loop  
15 of the supporting member 1 is transferred in such a manner that the first guiding roll 2 is positioned directly below the new reel spool.

Fig. 9 shows a situation in which a new reel spool accelerated to the web speed is brought in contact with the loop 1 of the supporting  
20 member. The old machine reel has moved forward in accordance with the growth of the diameter of the reel, and the paper web travels via the periphery of the roll 10 between the roll 10 and the new reel spool via the guiding roll 16, between the new reel spool and the first guiding roll further along the upper portion of the loop of the supporting  
25 member on the periphery of the old reel R. The reel R is brought in contact with the press roll 9. Similarly to the preceding example, the press roll 9' and 9'' can also be positioned above the horizontal diameter of the reel R that is being formed.

30 Fig. 10 shows a situation in which the web passed to the old reel R is changed to travel around the new reel spool.

Fig. 11 shows a situation in which the old, full reel spool R has been transferred forward to a removal position. The press roll 9 moves as  
35 well, being in constant contact with the surface of the reel. When the web layer of certain thickness has been accumulated around the new reel spool, the loop 1 of the supporting member is transferred in a

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manner indicated by the arrow against the travel direction of the web in such a manner that the surface of the new reel is positioned against the surface of the supporting member 1. One idea of the invention is that both the loading force caused by the roll, as well as the torque of its drive can be adjusted. Fig. 1 shows schematically one example of adjusting the loading force between the roll 10 and the reel R that is being formed, i.e. the linear load of the roll 10. In the primary reeling the roll 10 is supported at its ends in the reeling station in a manner known as such by means of hydraulic cylinders or corresponding loading members, by means of which the position of the roll as well as the nip force, i.e. the loading force is adjusted with respect to the reel spool 5. The ends of the roll 10 are equipped with weighing sensors that measure the nip force prevailing in the nip N2. The nip force measurement results 12 are transmitted to the control and adjustment unit 11, in which they are processed by means of control algorithms, and as a result of the processing a nip force control and adjustment message 13 is attained, which is transmitted to the hydraulic cylinders supporting the roll 10. The measurement of the nip force can be a continuous measurement, or it can take place at certain predetermined intervals. The essential aspect is that the measurement frequency is such that the adjustment of nip force on the basis of the measurements can be conducted sufficiently rapidly in view of the formation of the reel and in a repeated manner. The increase of nip force during the reeling tightens the bottom of the reel and the reduction of the same produces a softer reel. Fig. 1 also shows the adjustment of the torque of the drive of the roll 10, in which the driving torque necessary for rotating the roll is determined calculatorily by means of a frequency variable and electrical controls, or empirically, and the torque information 14 is transmitted to the control and adjustment unit 11. The driving torque can be monitored constantly or at fixed intervals. The control and adjustment unit 11 also contains control algorithms of the driving torque, by means of which a control message 15 is attained from the torque information 14 of the driving torque, said control message being transmitted to the motors driving the roll 10. The torque of the roll together with the web tension affect the tightness of the reel that is being formed in such a manner that when they are increased, the tightness of the reel increases as the reeling proceeds, and when they

are reduced, the tightness of the reel that is being formed is reduced, i.e. the reel becomes softer.

- 5 The control unit can contain both machine control and control of the electric drives. The electric drives can be adjusted either by means of speed or torque adjustment. The adjustment method is selected depending on the situation, and it can be changed during the operation of the reel-up, especially during threading, or when the reeling proceeds from one nip stage (N1, N2, N3) to another, or from one
- 10 center drive to another. The control of the electric drives can also be implemented by means of a separate control unit, wherein there is a gateway/link for communication between said separate control unit and the control unit performing the machine controls.
- 15 The tension of the web is measured by means of tension measurement. The web tension is adjusted by means of electric drives, either by adjusting the torque of the center drives, or by means of surface draw, within the limits of holding capacity. The holding capacity is affected by the nip load, the tension of the supporting member and
- 20 the friction coefficients between the web and the members touching the web. The web tension can also be adjusted without the tension measurement. Thus, the adjustment takes place on the basis of the calculation.
- 25 According to another idea of the invention the surface of the reel R that is being formed is tightened by means of so-called surface draw. The surface draw can be determined in such a manner that it is the torque difference between the two rotating members that are located successively in the travel direction of the web and are in contact with
- 30 the web. One alternative is to use the surface draw in the beginning of the reeling, wherein the surface of the reel R is tightened by the torque difference between the supporting member 1 and the roll 10, wherein it is possible to tighten the bottom of the reel. Another alternative is to adjust the tightness or hardness of the reel during the entire reeling process. Thus, in the beginning of the reeling the surface of the reel is
- 35 tightened in the above-described manner, i.e. by the torque difference between the supporting member 1 and the roll 10, and when the



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reeling proceeds, the surface of the reel is tightened by means of the torque difference between the supporting member 1 and the roll 9. In this alternative, if the aim is to ensure the adjustment of the tightness of the reel throughout the entire reeling process, the roll 9 is brought  
5 against the reel that is being formed at an earlier stage than presented in the embodiments shown in Figs 2 to 11 or 7 to 11, i.e. the roll 9 enters in contact with the reel R immediately after the primary reeling, i.e. at the stages shown in Figs 3 and 8. Figs 3 and 8 show the location of such a roll 9'''. The surface draw can also be attained in a different  
10 manner than that shown hereinabove, wherein two simultaneous draws are not necessarily required on the surface of the reel. Thus, the surface draw can be attained between the center drive of the reel and one member that is in contact with the surface of the reel R, for example at the primary reeling stage between the reel spool 5 and the  
15 roll 10, at the final reeling stage between the reel spool 5 and any of the rolls 9, 9', 9'' or 9''' or between the supporting member 1 and the reel spool 5.

Figs 12 to 17 show a second embodiment of the invention in which the  
20 roll 10 is in nip contact with the reel R that is being formed during the entire reeling process. In other words, the roll 10 is in contact with the reel R during both the primary and the secondary reeling. The roll 10 produces internal holding inside the surface layers of the reel within the entire width of the web, wherein the friction between the layers is  
25 increased and the reel can be better held together. This is especially helpful in reeling of slippery paper grades. Especially when moving the reel from the primary reeling device 7 to the secondary reeling device 17 by means of the roll 10 it is ensured that the surface layers of the machine reel are held together during the deceleration in the  
30 change. Furthermore, the roll 10 can be utilized in the braking of the finished reel, wherein for example part of the braking torque can be produced by means of the roll 10. Thus, the roll 10 can even tighten the surface of the reel during the braking process.

35 In the braking process shown in Figs 12 to 17, the supporting member 1 and the guiding rolls 2 and 3 guiding the same correspond to those presented in the embodiment above. The paper web W travels via the

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reeling nip N1 guided by the supporting member 1 onto the machine reel R, which is formed around a reel spool 5 rotatable with its own center drive. During the primary reeling the reel spool 5 is moved in the machine direction in relation to the loop of the supporting member 1 by means of the transfer device 7 that supports the bearing housings at the ends of the reel spool. The transfer device 7 is arranged to move on substantially horizontal reeling rails 6 extending in the machine direction. The transfer device 7 also functions as a primary reeling device for which purpose it is provided with drive devices. When the diameter of the machine reel R that is being formed grows in the primary reeling and the reel moves forward, it is in constant contact with the supporting member 1. When the reel that is being formed has moved to final end of the reeling rails 6, the reel spool and the reel R formed thereon are changed to the secondary reeling device 17 that is arranged at the final end of the reeling rails 6, in which the formation of the reel into its final size takes place. The secondary reeling device 17 is installed in a stationary or movable manner in connection with the reeling rails, and it has a drive device of its own. In connection with the reel-up, there is also a storage 18 of empty reel spools 5 (not shown), from where the reel spools are brought to the change station at the first guiding roll 2 in order to change the web conveyed to the machine reel R that is becoming full. The reel change takes place at the production speed. The storage of reel spools 18 and the reeling rails 6 are positioned horizontally in such a manner that the transfer device 7 is capable of retrieving the new reel spool directly from the storage 18. Thus, the reel spools move substantially on the horizontal plane from the storage 18 all the way to the finished machine reel. The position of the loop formed by the supporting member 1 is changed during the reeling process by moving either one or both guiding rolls 2 and/or 3 supporting the loop in such a manner that the reeling nip N1 is closed during the entire reeling process.

During the reeling, substantially during the entire reeling process, an auxiliary nip N2 is formed with the reel spool 5 by means of the roll 10. Similarly to the preceding embodiments, the roll 10 is positioned in the upper part of the reel spool 5, more precisely above the surface of the reel spool defined by its horizontal diameter. The roll 10 is in the axial

direction within its entire length in contact with the surface of the reel R, thus forming an auxiliary nip N2.

5 The roll 10 is attached to a supporting structure (not shown in the figures) that is mounted in connection with the reel-up. The supporting structure is formed in such a manner that it is possible to move the roll 10 in the supporting structure in such a manner that the roll 10 remains in nip contact with the reel R that is being formed substantially during the entire reeling process. The figure shows as an example a travel  
10 path 19 of the roll 10 having a rectangular cross-section, in which the roll moves along vertical or horizontal lines 20 of the travel path. It is, of course, possible to apply other kinds of travel paths for bringing the roll 10 against the reel spool. For moving the roll, the supporting structure has drive devices of its own (not shown in the figures).

15

Fig. 12 shows a situation in the beginning of the reeling process in which the reel spool 5 forming the core of the new reel has been moved from the storage 18 of the reel spools in contact with the supporting member 1 by means of the transfer device 7. The loop of  
20 the supporting member 1 has been transferred in the vertical direction in such a manner that the first guiding roll 2 can be positioned directly below the new reel spool 5. Thus, a so-called hard nip is formed with the guiding roll 2 supporting the supporting member 1. Before this the new reel spool 5 has been accelerated to the web speed with the drive  
25 of the transfer device 7, and the roll 10 has been brought in contact with the reel spool 5, wherein an auxiliary nip N2 is formed. The cut web W is guided to travel around a new reel spool 5, between the empty reel spool 5 and the first guiding roll 2 of the supporting member 1, and further via the nip N2. The roll 10 is also brought in contact with  
30 the reel spool 5, wherein the web also travels via a nip N2 formed by the same. The finished old reel R is located in the secondary reeling device 17, and it is still in contact with the supporting member 1.

35 Fig. 13 shows a situation in which some amount of new machine reel R has been formed around the new reel spool 5. As can be seen in the figure, as the size of the machine reel increases, the position of the roll on the travel path 19 has changed when compared to its position in

## 15

Fig. 12. The roll 10 is still in nip contact with the surface of the machine reel R that is being formed. The loop of the supporting member 1 has been moved in such a manner that the first guiding roll 2 moves further away from the new reel and the web is guided on the new reel at such a point where the surface of the reel is positioned against the portion of the supporting member that follows the guiding roll 2, and that the old, full reel machine reel R is no longer in contact with the loop of the supporting member 1.

10 In the situation shown in Fig. 14 the position of the loop of the supporting member and the location of the reel that is being formed with respect to the supporting member has remained the same as in the situation shown in the preceding figure, but the old reel R has been transferred away from the secondary reeling device 17.

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Fig. 15 shows a situation in which the reel that is being formed has been transferred forward by means of the transfer device 7 in the machine direction towards the secondary reeling device 17. The position of the loop of the supporting member has changed when the size of the reel R has grown in such a manner that the reeling nip N1 is closed. The position of the reel 10 within the travel path 19 has also changed and it is still in nip contact with the surface of the growing machine reel.

25 Fig. 16 shows a situation in which the reel spool and the machine reel R formed thereon is changed from the transfer device 7 functioning as a primary reeling device to the secondary reeling device 17. The position of the loop of the supporting member 1 and the location of the roll 10 on the travel path 19 have also changed. When the machine reel R has been transferred to the secondary reeling device 17, the transfer device 7 is free to move along the rails 6 in the machine direction against the storage 18 of reel spools 5.

35 Fig. 17 shows a situation in which the reeling of the machine reel R continues in the secondary reeling device 17. The roll 10 still forms a nip N2 with the machine reel that is being formed. The transfer device 7 to which a new empty reel spool 5 has been transferred is waiting in

the storage 18 of reel spools for the beginning of a new reeling sequence.

5 Figs 12 to 17 also show a roll 10' equipped with a center drive whose operating principle is the same as that of the roll 10 and which moves on the same travel path 19 with the roll 10. The roll 10' also affects the formation of the reel in a similar manner as the roll 10. The roll 10' also forms a nip N2 with the roll R and it follows the reel that is being formed from the beginning of the reeling until the end of the process. Figs 12 and 13 show a roll 10' that is in contact with the surface of the finished machine reel R. In other words, in Figs 14 to 17 the roll 10' waits for the progress of the reeling of the preceding reel, in which reeling process the roll 10 takes care of the formation of the auxiliary nip N2. When the reeling of the new reel begins, the reel 10' moves in contact with the new reel spool accelerated into web speed, thus forming an auxiliary nip N2. In the embodiment of Figs 12 to 17 there are thus two rolls that alternately follow the reel that is being formed during the entire reeling process, and form an auxiliary nip N2 with the reel that is being formed. Thus, it is not necessary to change the roll that is in contact with the reel in the middle of the reeling process. The same roll 10 or 10' also assists in the braking of the finished reel that is to be stopped. The roll 10' can be arranged movable in the same supporting structure with the roll 10, wherein they have a similar travel path 19, as shown in the figures, or it can be arranged in a separate supporting structure of its own. It should be noted that the travel path 19 illustrating the moving of the rolls 10 and 10' is for the sake of clarity shown in a highly reduced manner in Figs 12 to 17. By means of the supporting structures of the rolls 10 and 10' not shown in the figures it is possible to move the rolls past each other in the situation of starting a new roll (Figs 16 and 17). For example the rolls 10 and 10' can be suspended above the reel-up from a beam extending in the machine direction, and to enable the passing of the rolls the supporting structures of the rolls 10 and 10' can also have different widths in the cross direction of the reel-up and the rolls can also be lifted over each other.

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It is also possible to implement the embodiment of Figs 12 to 17 in such a manner that only one roll 10 is used, said roll following the reel



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that is being formed only in a part of the reeling process. Because the reeling takes place as a continuous reeling process, there are stages in which for example the roll 10 forms an auxiliary nip N2 with the nearly finished reel R, but the primary reeling of a new reel has already begun. The primary reeling is thus performed without the roll 10 and the auxiliary nip N2 formed by means of the same. Similarly, if the roll 10 is arranged in contact with the reel spool 5 at the primary reeling stage, the reeling of the simultaneously reeled nearly finished reel R takes place without the roll 10.

10

The invention is not intended to be limited to the embodiments presented as examples above, but the invention is intended to be applied widely within the scope of the inventive idea as defined in the appended claims. For example the transfer of the supporting member in the machine direction as shown in Figs 3 to 5 and 8 to 10 is not necessary, but the supporting member can be kept in the position shown in Figs 6 and 2 and 7 and 11 during the entire reeling process. It is also possible that at the initial stage of the reeling the first guiding roll 2 in the travel direction of the web does not form a "hard nip" with the reel that is being started, but the reeling takes place all the way from the beginning by means of the supporting member 1 and the "soft nip" N1 formed by the reel that is being started. Thus, in the beginning of the reeling, there is one hard nip N2 in use. Also in this embodiment the supporting member 1 remains stationary during the entire reeling process.

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The invention can also be applied during the threading of the web. For anyone skilled in the art, it is of course obvious that the method according to the invention can also be applied in a re-reeler or in a calender reeler.

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## Claims:

1. A method in reeling up, in which a paper web or the like (W) is reeled around a center-driven reel spool (5) and the reel spool (5) is transferred from the primary reeling to the secondary reeling in which reeling the reel spool (5) is transferred in accordance with the growth of the reel by means of a transfer device (7) at least at some stage of the reeling and the web is brought at said stage from below the reel spool (5) via a reeling nip (N1) formed by the reel spool (5) and a loop (1) of an endless supporting member, **characterized** in that during the reeling process, at least at some stage, an auxiliary nip (N2) is formed by means of the reel spool (5) and a roll (10, 10''), via which the web (W) is guided around the reel spool.
2. The method according to claim 1, **characterized** in that the web (W) is guided around the reel spool (5) during the reeling in the travel direction of the web (W) in such a manner that the web (5) is guided via the loop (1) of the supporting member to the reeling nip (N1) and then to the auxiliary nip (N2).
3. The method according to claim 1, **characterized** in that the web (W) is guided around the reel spool (10) during the reeling in the travel direction of the web (W) in such a manner that the web (5) is guided via the periphery of the roll (10) to the auxiliary nip (N2) and then to the reeling nip (N1).
4. The method according to claim 1, **characterized** in that the auxiliary nip (N2) is formed during the primary reeling.
5. The method according to claim 4, **characterized** in that the auxiliary nip (N2) is also formed during the secondary reeling.
6. The method according to any of the preceding claims 1 to 4, **characterized** in that the auxiliary nip (N2) is formed by means of the roll (10, 10'') for the duration of the threading of the web (W).

7. The method according to any of the preceding claims 1, 3 or 4, **characterized** in that the roll (10, 10') is arranged to function as a guiding roll for the web.

5 8. The method according to any of the preceding claims 1 to 7, **characterized** in that the reeling nip (N1) is formed below the surface of the reel spool defined by the horizontal diameter of the reel spool (5).

10 9. The method according to any of the preceding claims 1 to 8, **characterized** in that the auxiliary nip (N2) is formed above the surface of the reel spool limited by the horizontal diameter of the reel spool (5).

15 10. The method according to claim 4, **characterized** in that during the secondary reeling a nip (N3) is formed by means of the reel (R) and a press roll (9, 9', 9'', 9''').

20 11. The method according to claim 1 or 4, **characterized** in that the reel spool (5) is transferred by means of the transfer device (7) during the secondary reeling.

25 12. The method according to claim 1 or 5, **characterized** in that the reel spool (5) is transferred by means of the transfer device (7) during the primary reeling.

30 13. The method according to any of the claims 1 to 12, **characterized** in that in the axial direction the shell of the roll (10, 10') is at least as long as the width of the web in its cross direction, preferably the shells of the roll (10, 10') and the reel spool (5) are equally long in the axial direction.

35 14. The method according to any of the preceding claims 1 to 13, **characterized** in that the primary reeling is adjusted by means of the nip force produced by the roll (10, 10').

15. The method according to claim 14, **characterized** in that the nip force produced by the roll (10, 10') is measured and the measurement

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result (12) is transmitted to a control and adjustment unit (11) in which a nip force control and adjustment message (13) is formed.

5 16. The method according to any of the preceding claims 1 to 14, characterized in that the primary reeling is adjusted by means of the torque of the roll (10,10').

10 17. The method according to claim 16, **characterized** in that the torque of the roll (10, 10') is measured, and the measurement result (14) is transmitted to the control and adjustment unit (11) in which a torque control message (15) is formed.

15 18. The method according to any of the preceding claims 1 to 14, characterized in that the reeling is adjusted by means of the surface draw of the paper web (W).

20 19. A reel-up which comprises means for reeling a paper web or the like (W) around a center-driven reel spool (5), said means comprising a transfer device (7) for transferring the reel spool (5) in accordance with the growth of the reel, wherein the reel-up also comprises an endless supporting member (1) and a reeling nip (N1) formed by means of the loop of the endless supporting member (1) and the reel spool (5), **characterized** in that the means for reeling comprise a roll (10, 10') which together with the reel spool (5) form an auxiliary nip (N2) via  
25 which the web (W) is guided around the reel spool (5).

30 20. The reel-up according to claim 19, **characterized** in that the means for reeling comprise means both for primary and secondary reeling.

21. The reel-up according to claim 19 or 20, **characterized** in that the roll (10, 10') together with the reel spool (5) forms an auxiliary nip (N2) during the primary reeling.

35 22. The reel-up according to claim 21, **characterized** in that the roll (10, 10') together with the reel spool (5) also forms an auxiliary nip (N2) during the secondary reeling.

## 21

23. The reel-up according to claim 19, **characterized** in that in the shell of the roll (10, 10') is in the axial direction at least as long as the width of the web in its cross direction, preferably as long as the length of the shell of the reel spool (5) in the axial direction.
24. The reel-up according to claim 21, **characterized** in that the means for reeling comprise a press roll (9, 9', 9'', 9'''), which, together with the reel (R) forms a nip (N3) during the secondary reeling.
25. The reel-up according to any of the claims 19, 20 or 21, **characterized** in that the transfer device (7) is arranged to move the reel spool (5) during the secondary reeling.
26. The reel-up according to any of the claims 19, 20 or 22, **characterized** in that the transfer device (7) is arranged to move the reel spool (5) during the primary reeling.
27. The reel-up according to claim 19 or 20, **characterized** in that the reel-up is provided with a control and adjustment unit (11) to adjust the reeling.
28. The reel-up according to claim 19, **characterized** in that the auxiliary nip (N2) is arranged to be formed for the duration of the threading of the web (W).



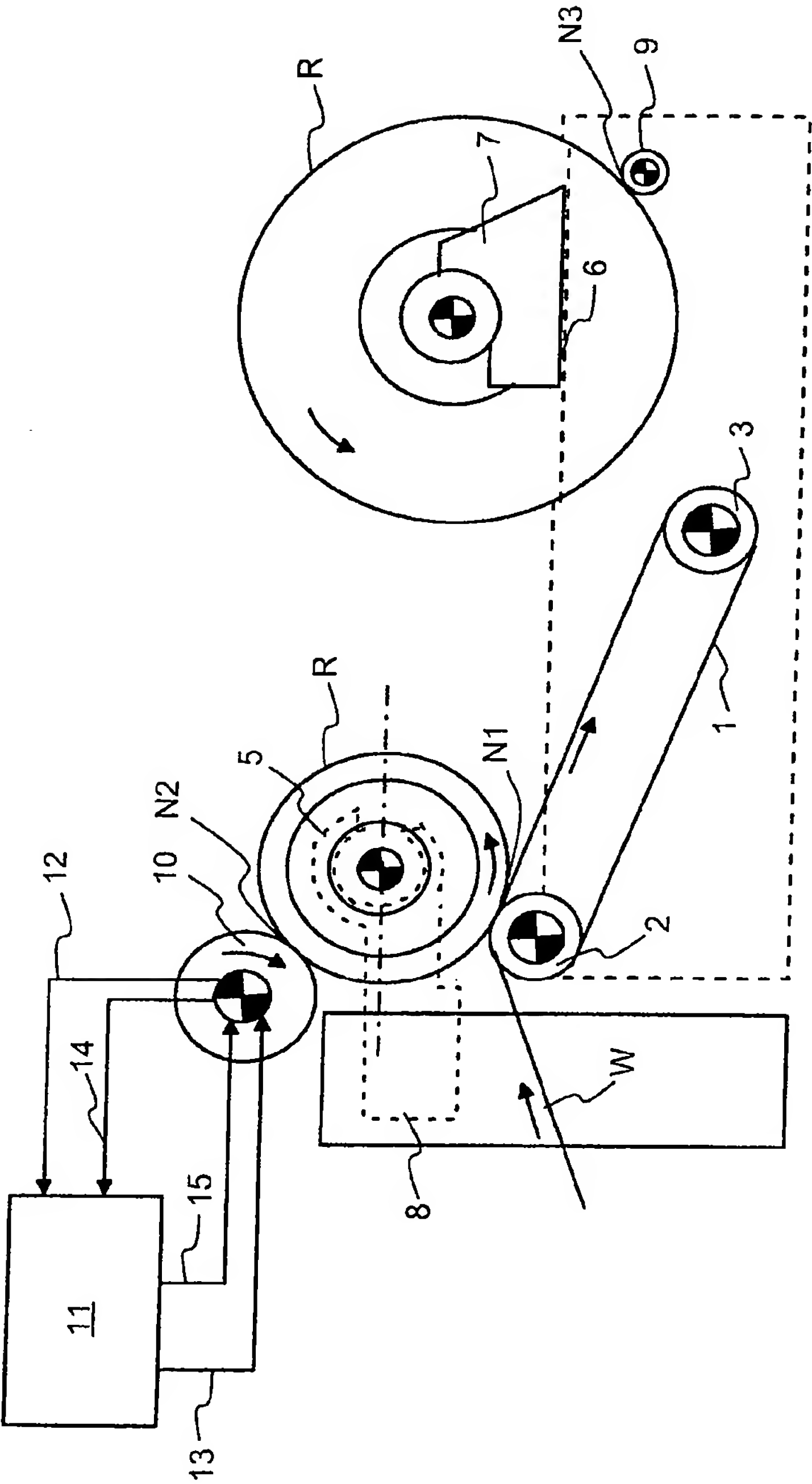


Fig.1

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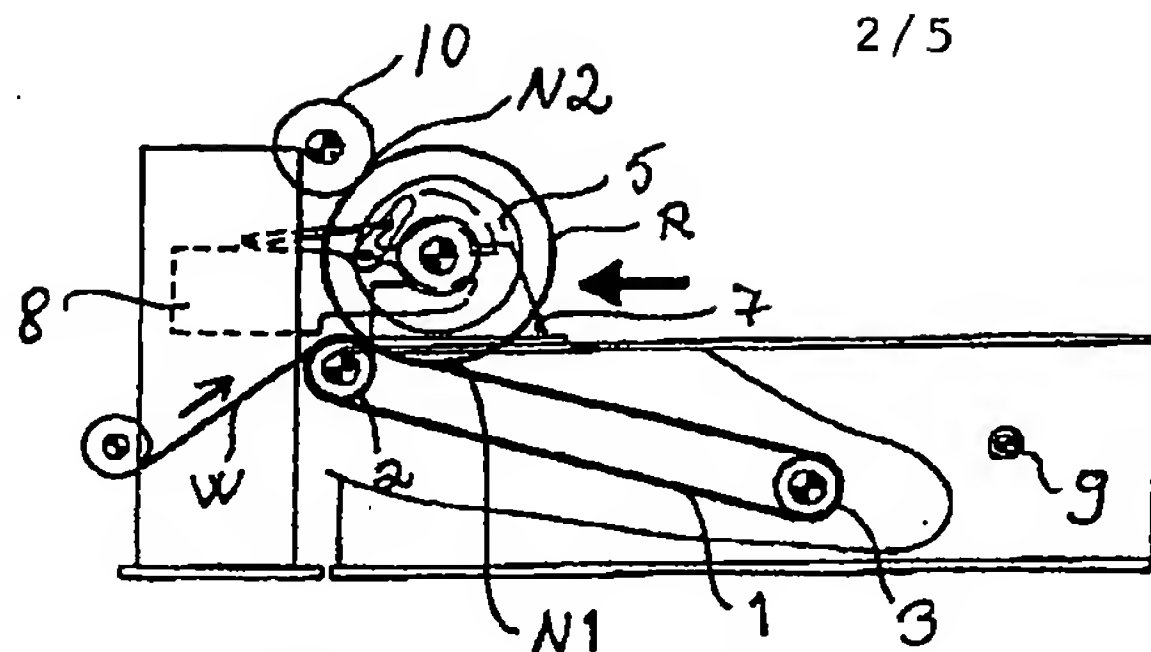


Fig. 2

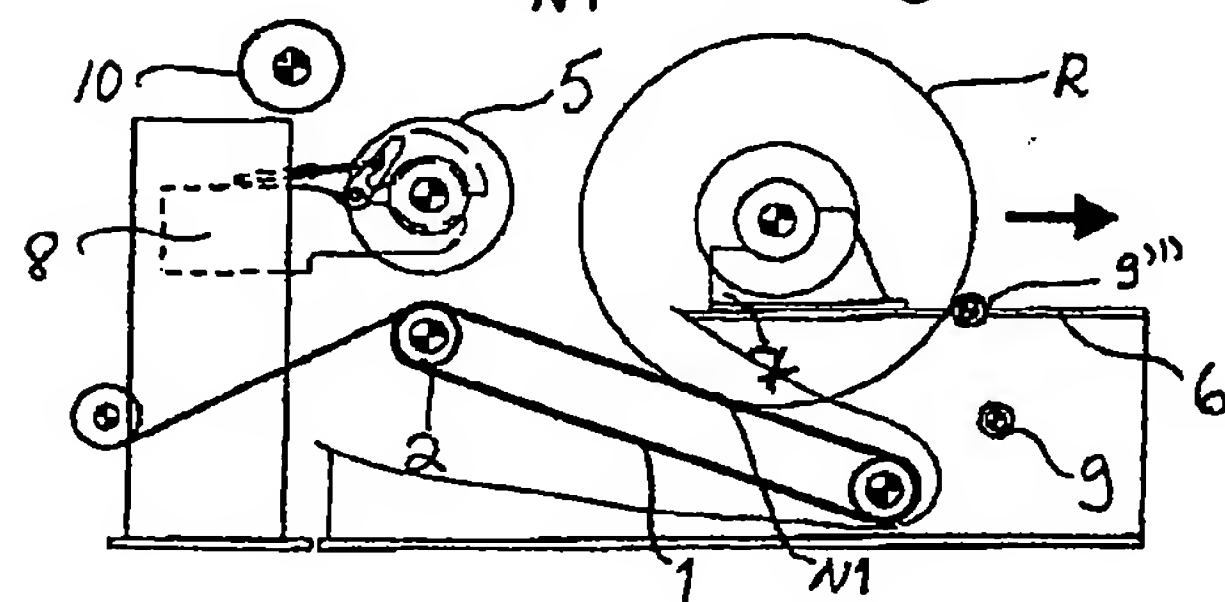


Fig. 3

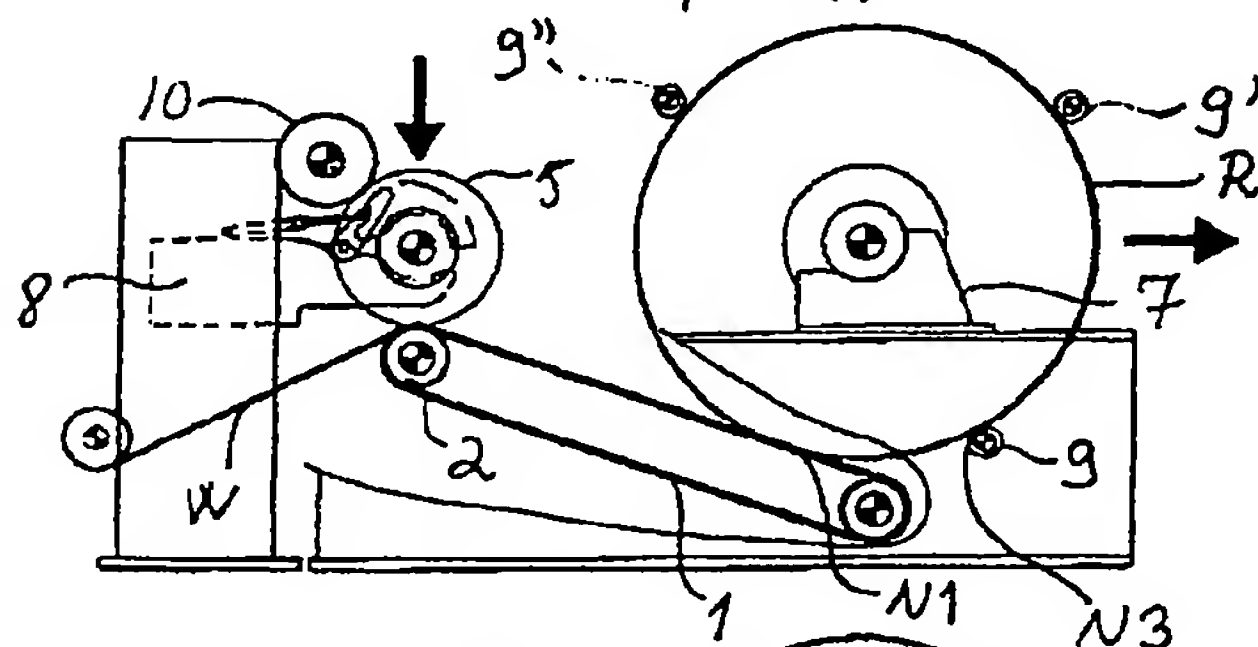


Fig. 4

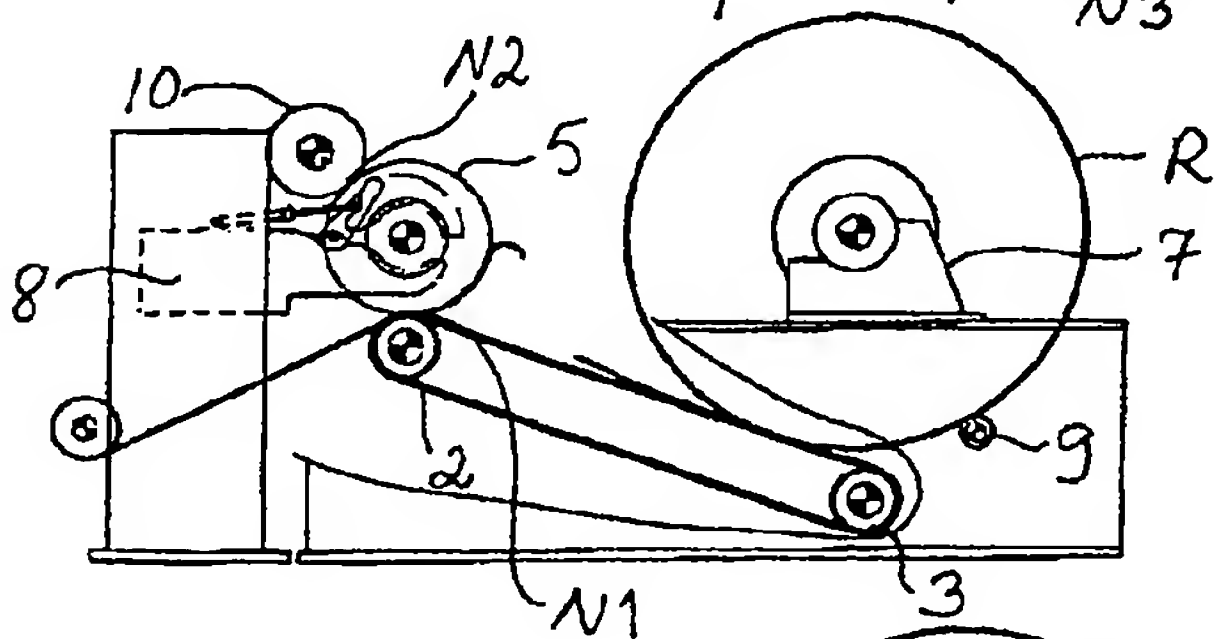


Fig. 5

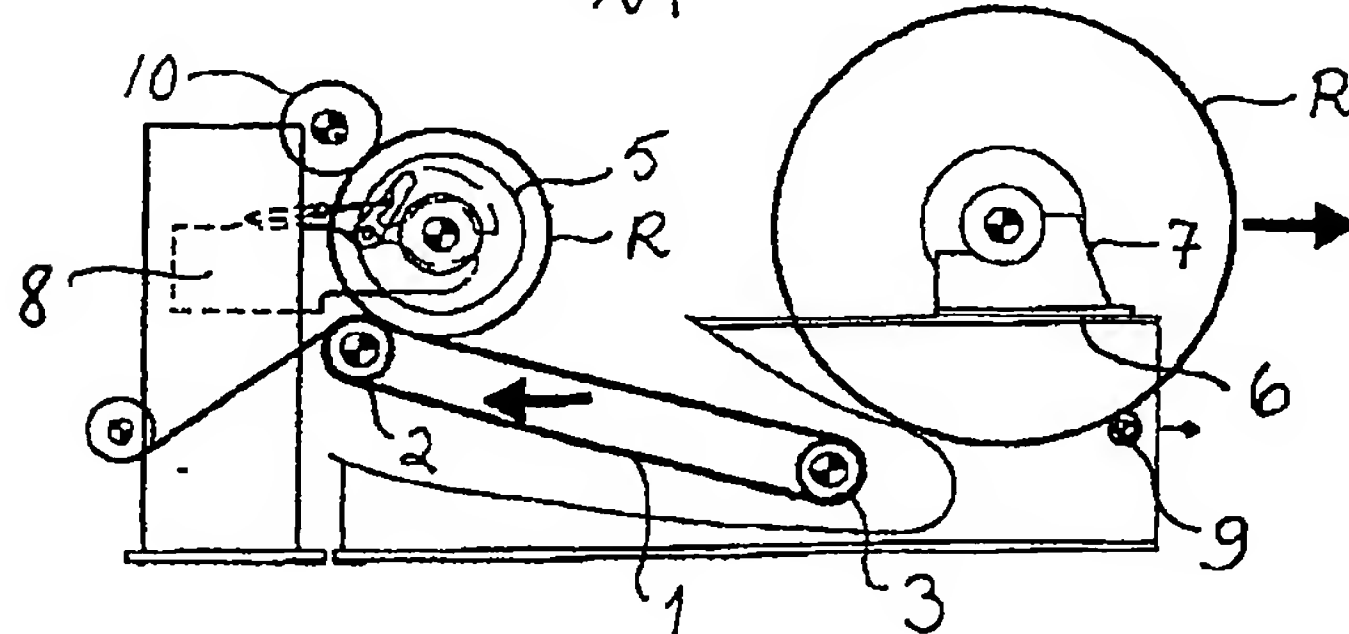


Fig. 6

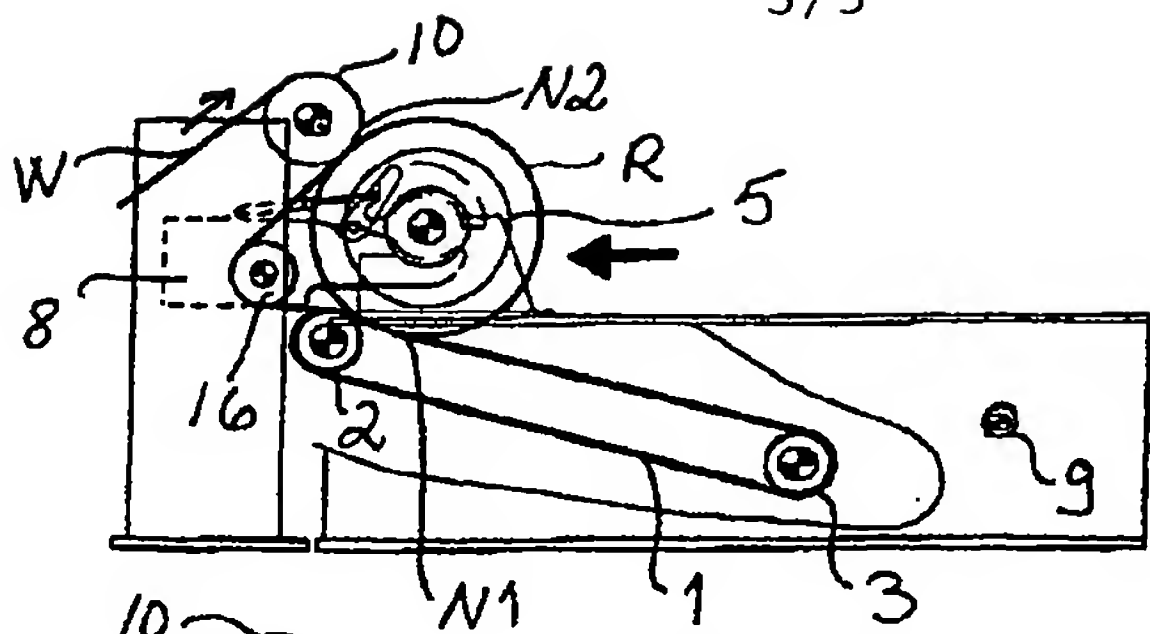


Fig. 7

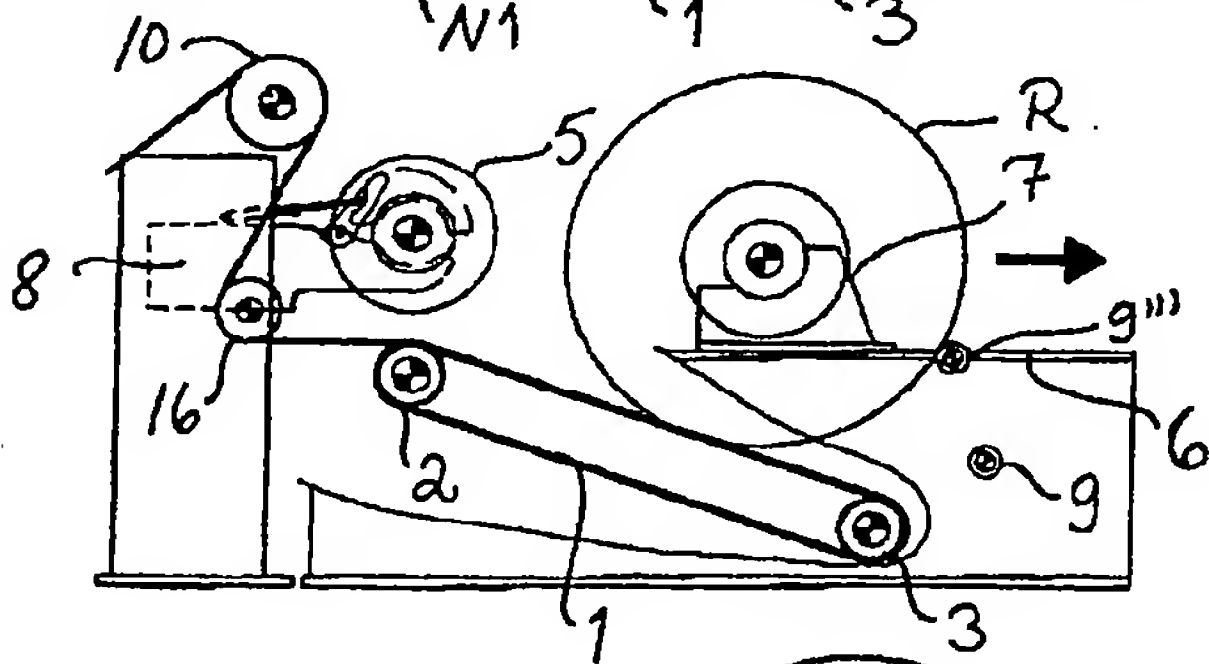


Fig. 8

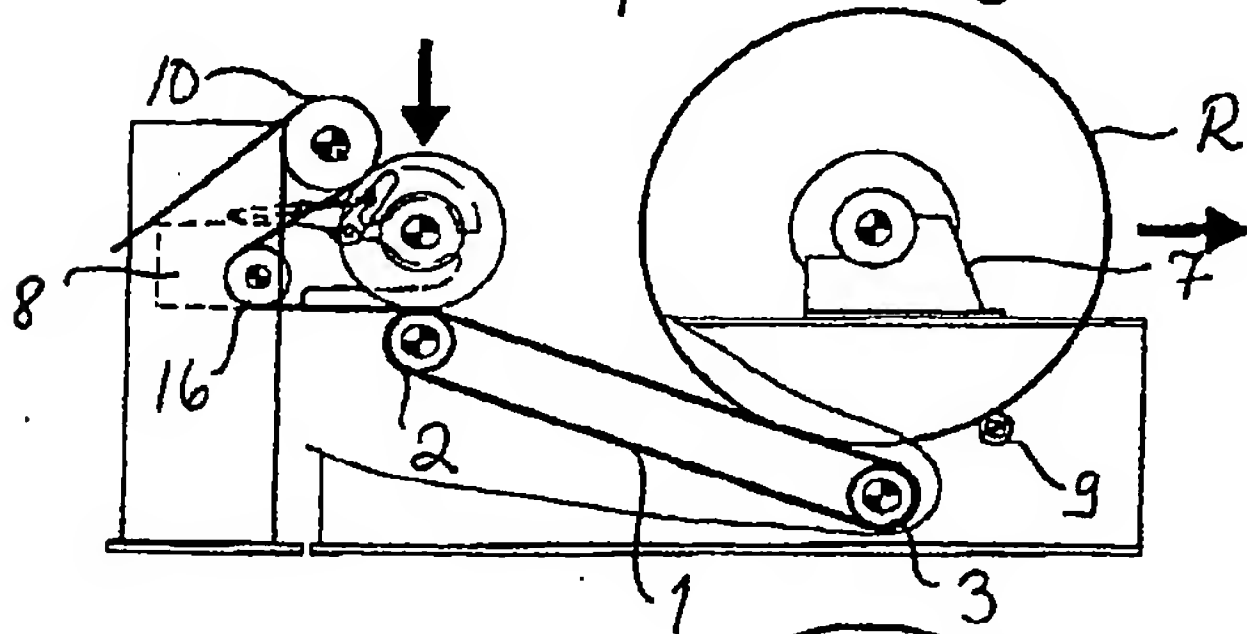


Fig. 9

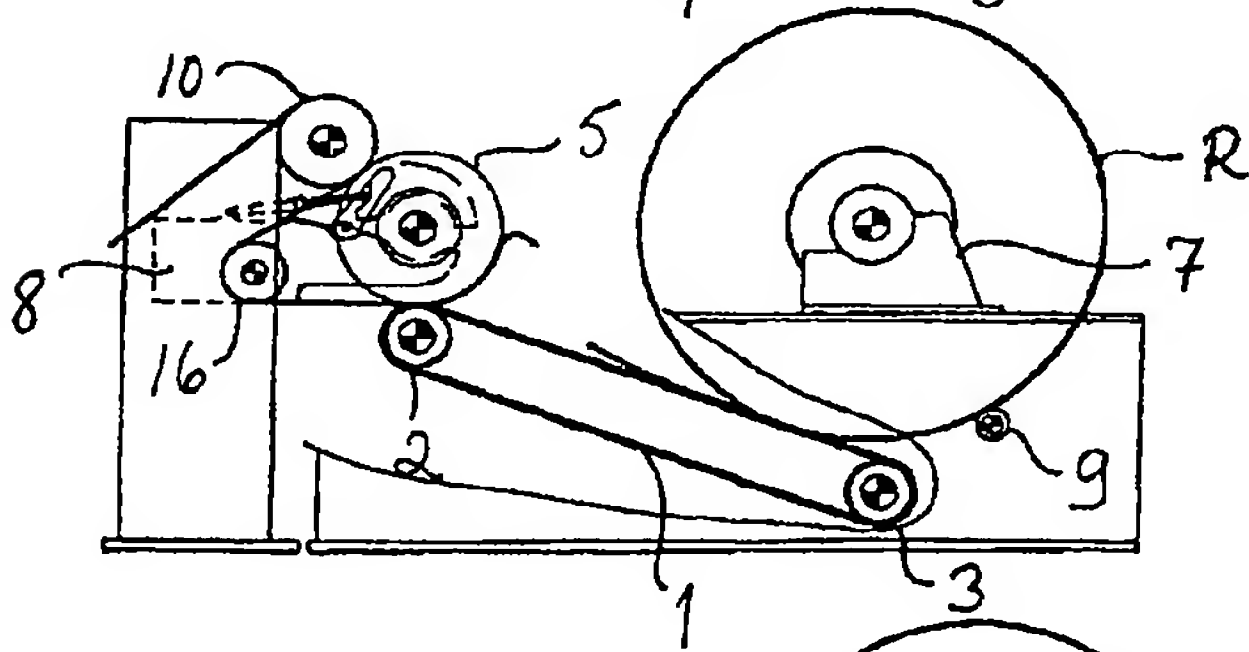


Fig. 10

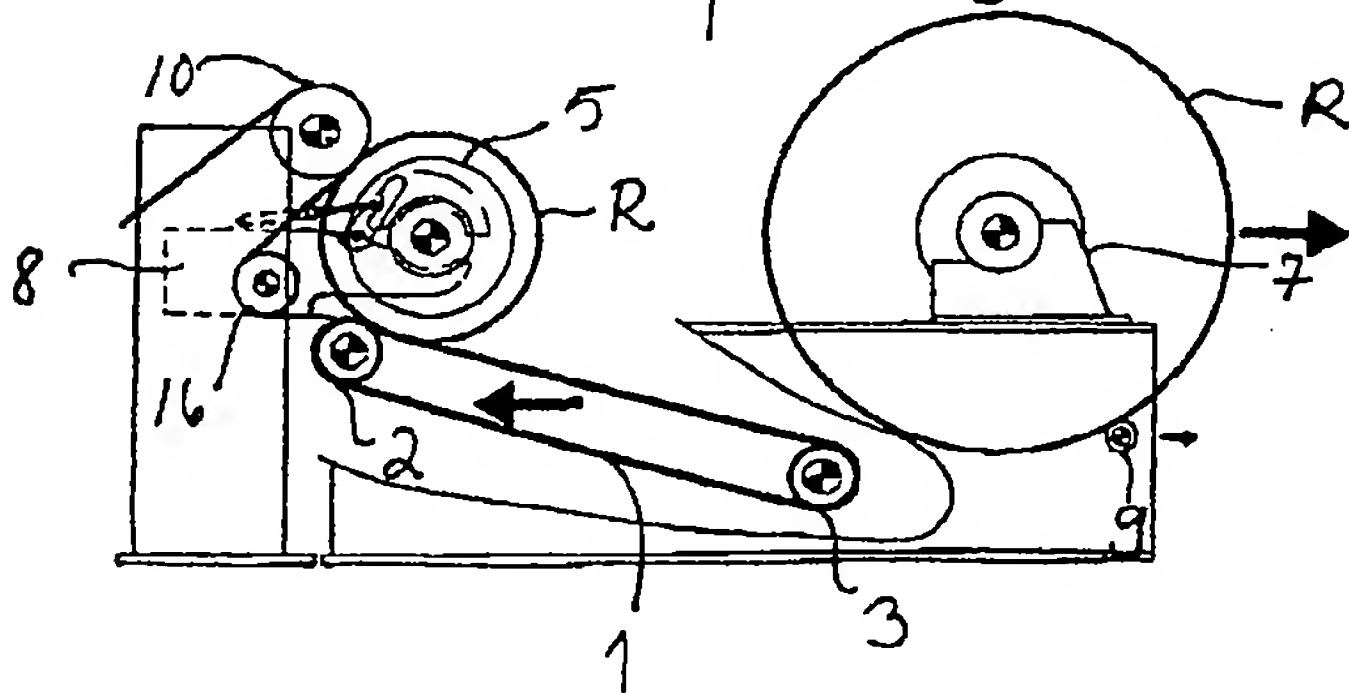


Fig. 11

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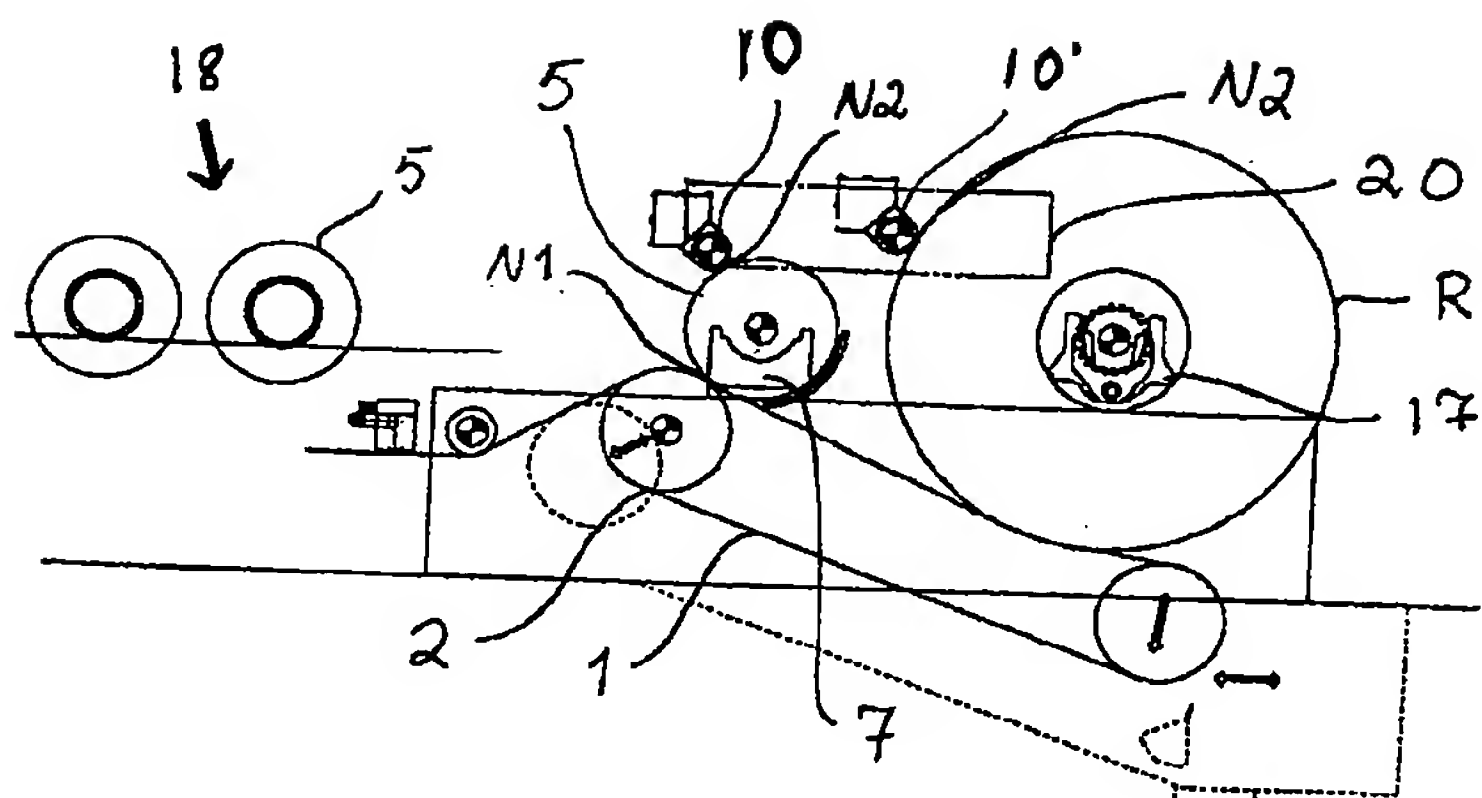


Fig. 12

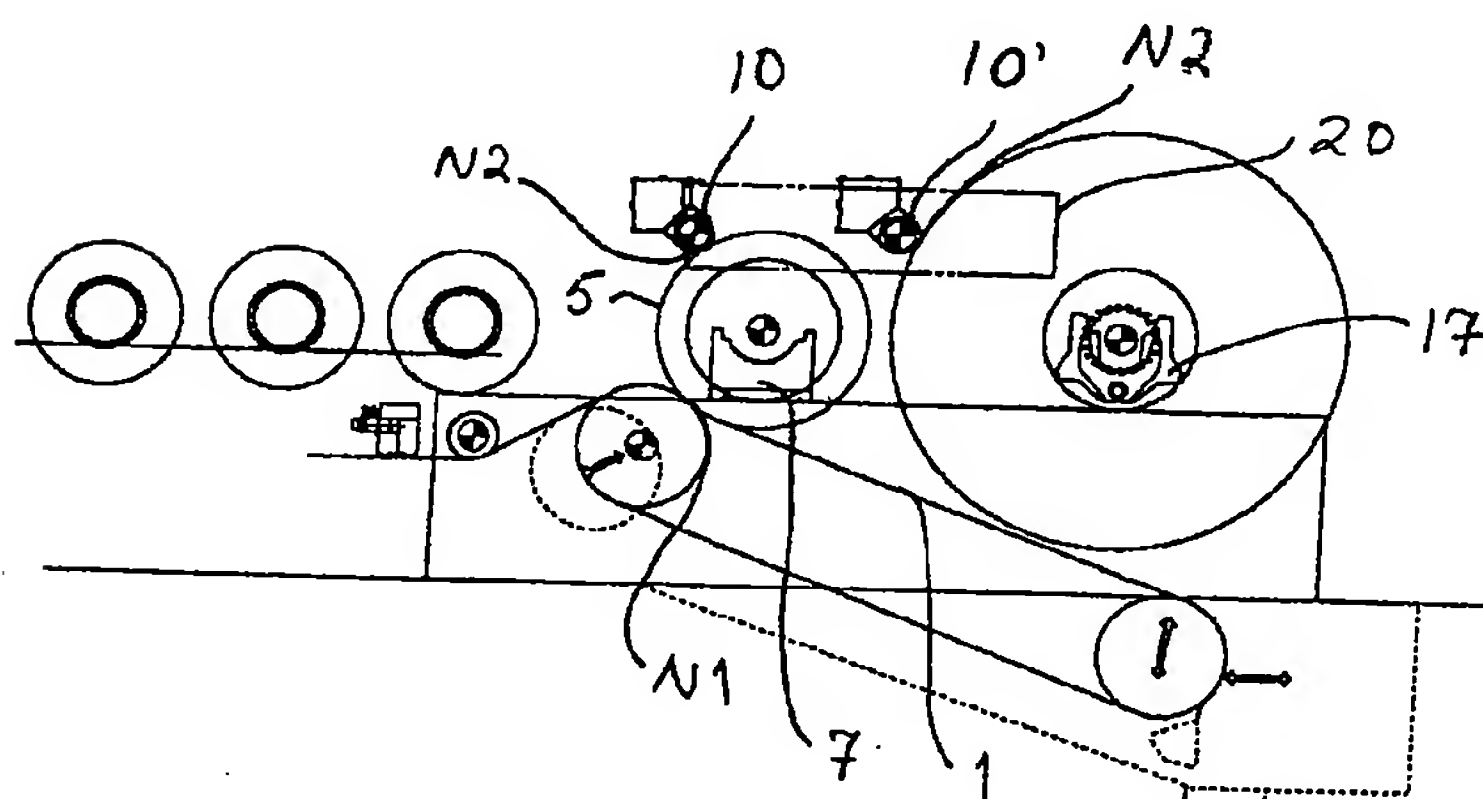


Fig. 13

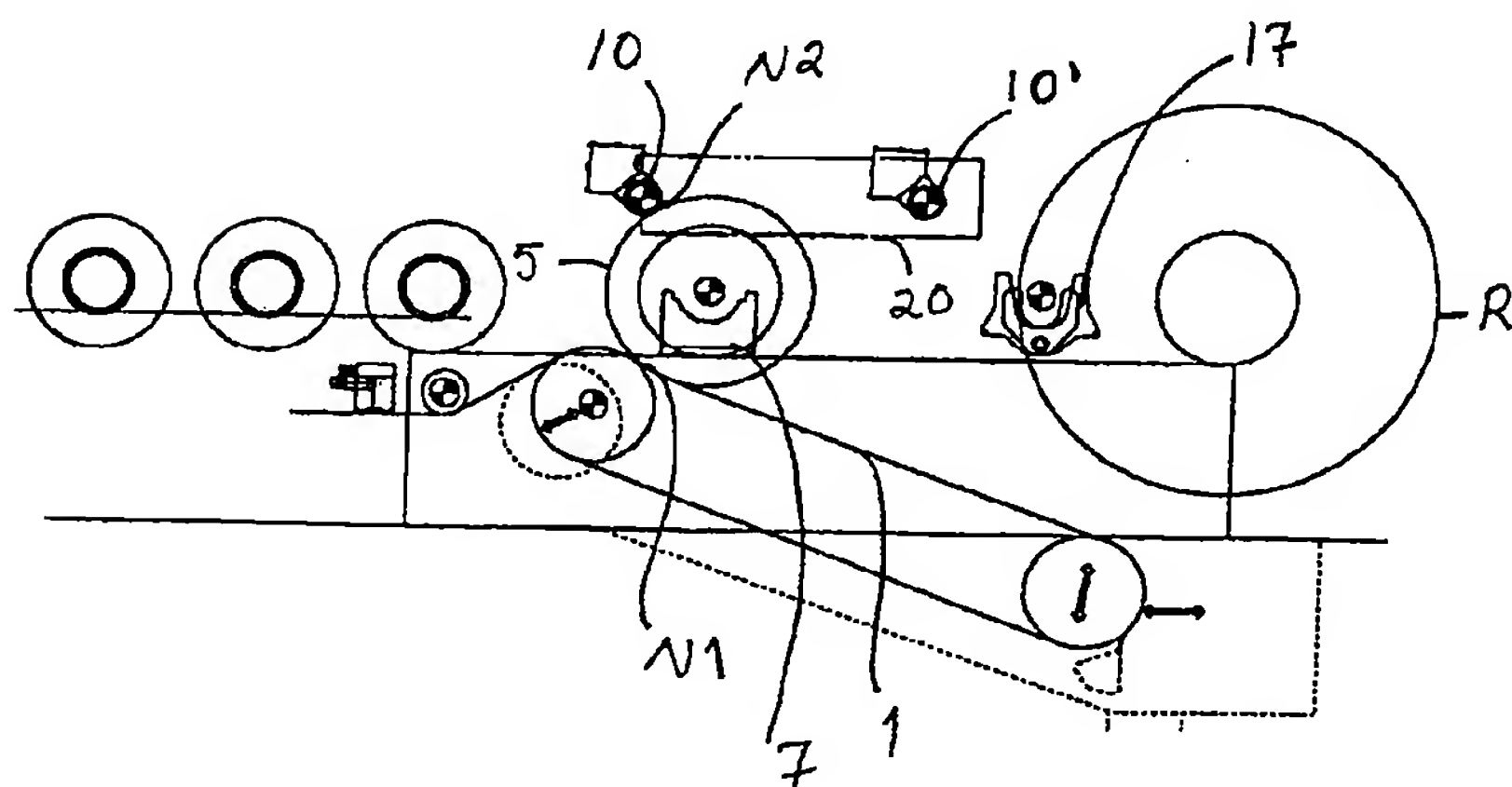


Fig. 14

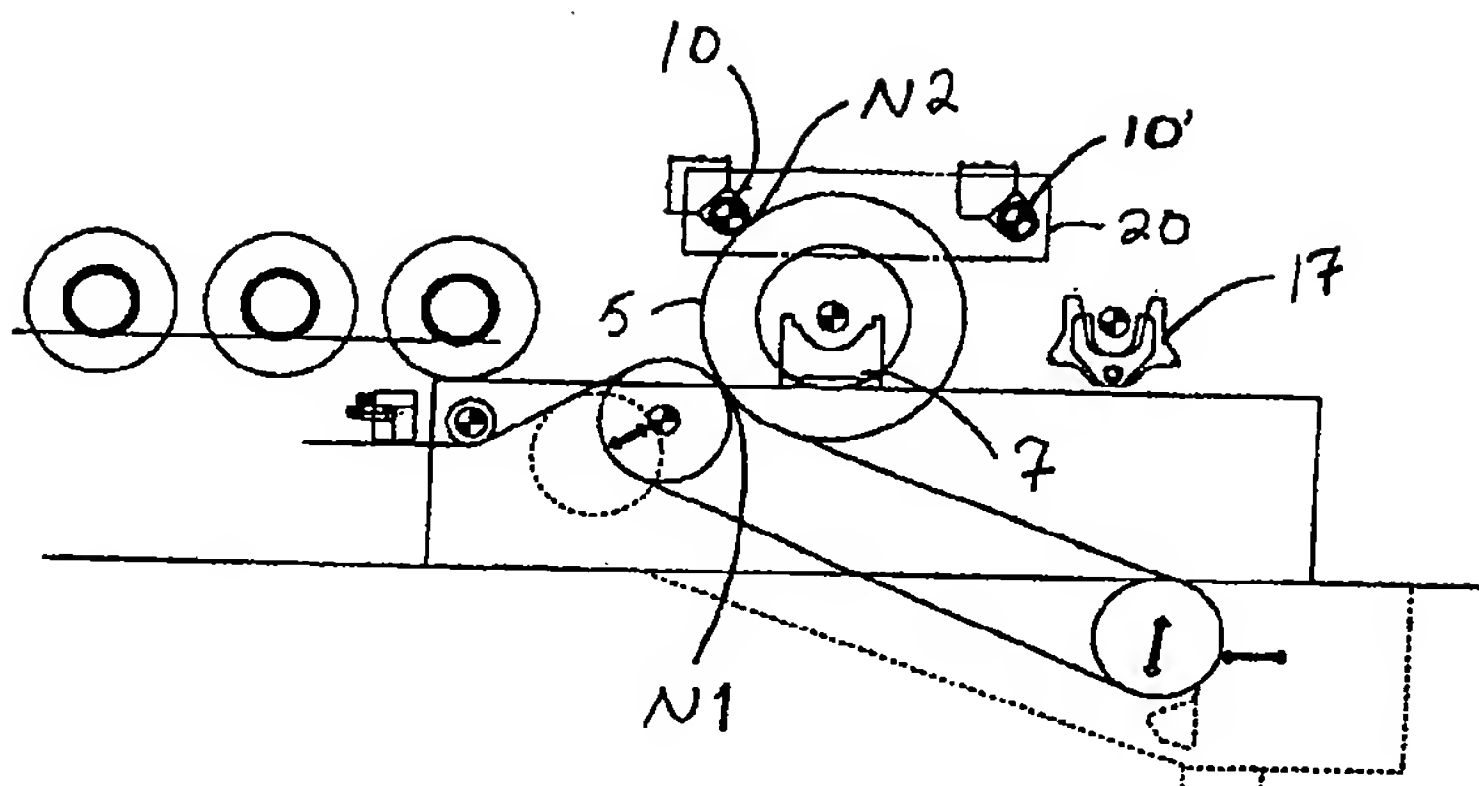


Fig. 15

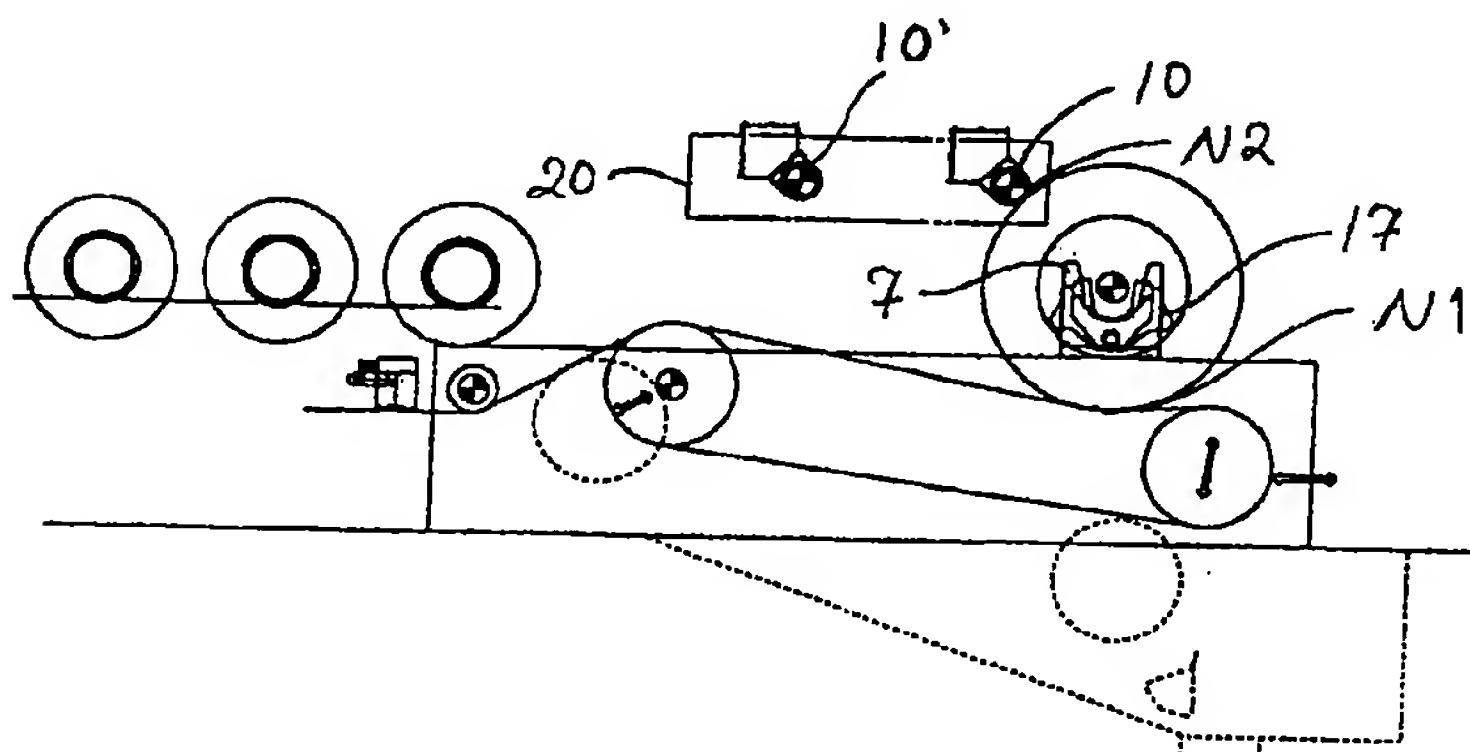


Fig. 16

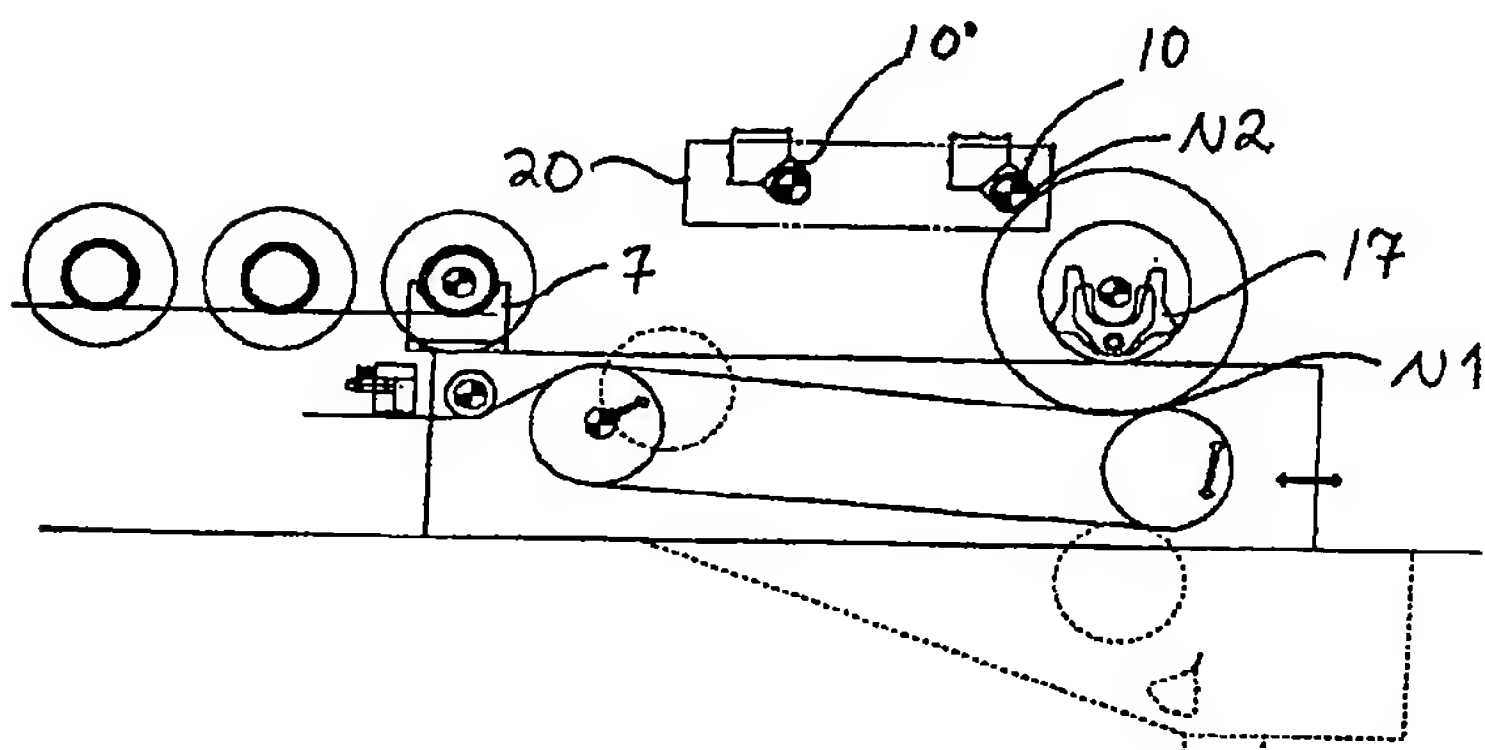


Fig. 17



## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/FI2005/050030

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 B65H18/26

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)  
EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X A	US 2002/079401 A1 (BIRKE ROLAND ET AL) 27 June 2002 (2002-06-27) the whole document	1,2,4, 6-18 3,5
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A	US 5 531 396 A (KINNUNEN ET AL) 2 July 1996 (1996-07-02) cited in the application	
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☒ Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search

29 July 2005

Date of mailing of the international search report

22/08/2005

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European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Haaken, W

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/FI2005/050030

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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